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Abstract

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THERMIONIC METHOD OF DIRECT HEAT - TO - ELECTRICITY CONVERSION

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I. Possibilities of application of thermionic heat-to-power converter in nuclear engineering are discussed for middle- and low-power nuclear reactors.

2. The results of theoretical and experimental investi - gations of fundamental converter processes in various operating conditions (low-pressure with charge neutralization, low-mean-free-path limit, low-voltage-are limit) are presented. Physical and technical features of these operating conditions are considered.

The results of investigations of surface ionization and thermoelectron emission properties for main refractory and design materials are also presented, including characteristics of therminonic low-pressure converter with charge neutralization. Thermoemission constant values are briefly discussed.

In the report there are considered theoretical and experimental results concerning voltage-current characteristics of the converter in the low-mean-free-path limit, saturation-current and optimal power dependence on the electrode temperature, gas pressure and emission properties of electrodes. The heat-flux carried over from a cathode by electrons and the converter efficiency are calculated. Some physical parameters of the con-

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verter are obtained on the basis of comparison of theoretical and experimental data.

The investigation of the converter in low-voltage-arc conditions is of special interest. Voltage-current characteristics, power output and their dependence on emission parameters, electrode temperatures and gas pressure are presented. Breakdown voltage dependence on gas pressure and cathode temperature is given. Results of probe measurements of electron temperature, density and potential distribution for low-voltage-arc in cesium vapours are also presented.

The influence of external magnetic field on the thermionic converter and low-voltage-arc is investigated. The dependence of voltage-current characteristics and breakdown potential along and across the magnetic field are presented. In addition there was investigated also (theoretically and experimentally) the dependence of saturation-current and voltage-current characteristics of the converter on magnetic-field-strength.

There are given results concerning theoretical and experimental examinations of current fluctuations of the converter. Conditions resulted in appearing fluctuations and dependence of fluctuation frequency on different physical parameters are considered. The reason of appearing these fluctuations is studied theoretically.

3. There are considered fundamental scientific and technical problems needed to be solved to create thermionic emission converter with a nuclear reactor as a source of heat.